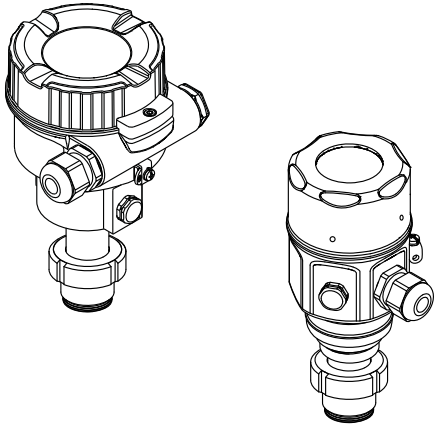
KA01033P/00/EN/17.16
71316889

Brief Operating Instructions **Deltapilot M FMB50, FMB51, FMB52, FMB53**

Hydrostatic level measurement

HART COMMUNICATION PROTOCOL



These Instructions are Brief Operating Instructions; they are not a substitute for the Operating Instructions pertaining to the device.
Detailed information about the device can be found in the Operating Instructions and the other documentation:

Available for all device versions via:
– Internet: www.endress.com/deviceviewer
– Smart phone/tablet: *Endress+Hauser Operations App*

Endress+Hauser
People for Process Automation

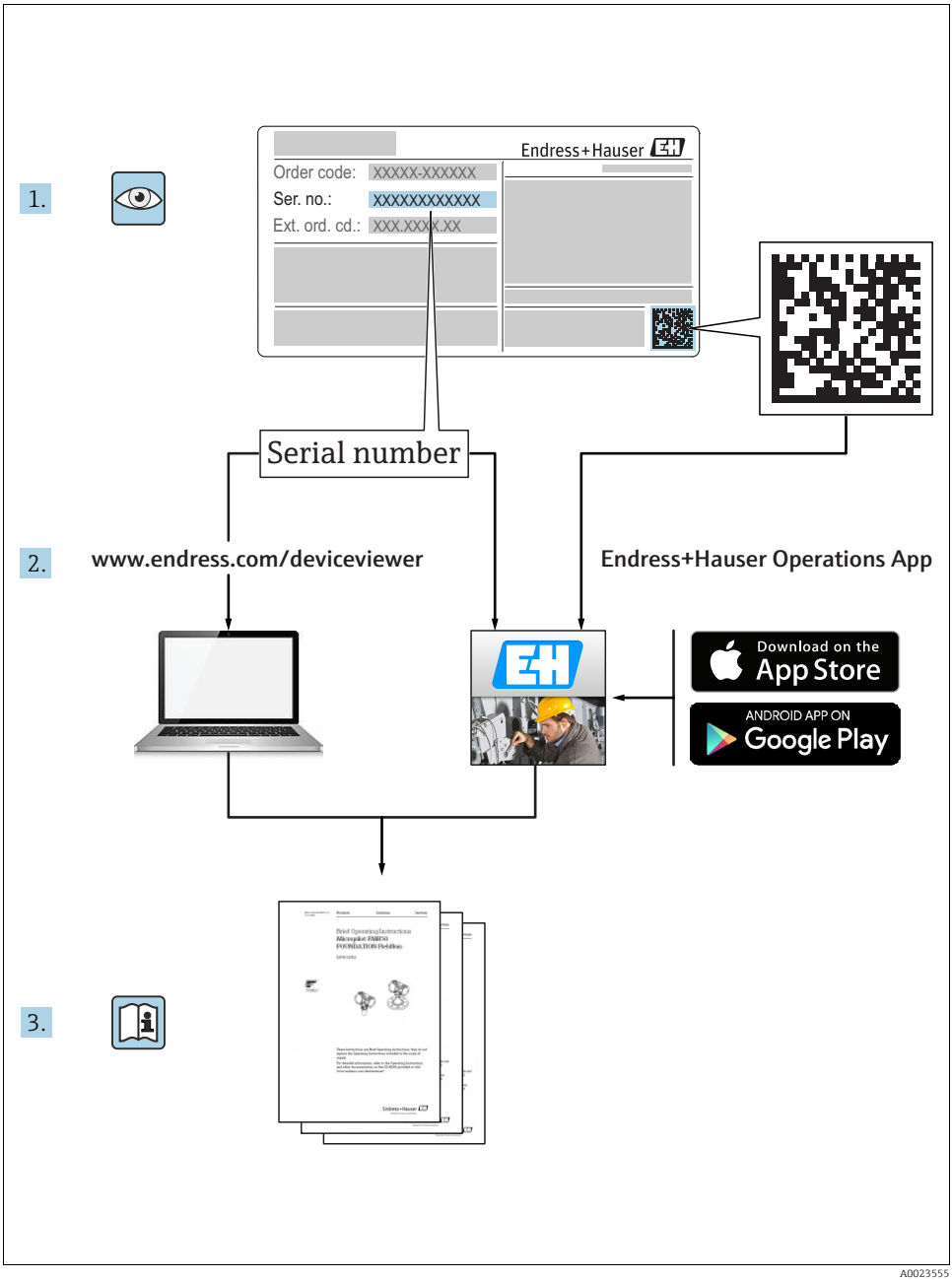

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX.XXXX.XX
Serial number
2.
www.endress.com/deviceviewer
Endress+Hauser Operations App
Download on the App Store
ANDROID APP ON Google Play
3.

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Table of contents

1 Document information

1.1 Document function

These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

1.2 Symbols used

1.2.1 Safety symbols

Symbol	Meaning
 A0011189-DE	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in seriousor fatal injury.
 A0011190-DE	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in seriousor fatal injury.
 A0011191-DE	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minoror medium injury.
 A0011192-DE	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personalinjury.

1.2.2 Electrical symbols

Symbol	Meaning	Symbol	Meaning
	Direct current		Alternating current
	Direct current and alternating current		**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.		**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

1.2.3 Tool symbols

Symbol	Meaning
 A0011221	Allen key
 A0011222	Hexagon wrench

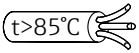
1.2.4 Symbols for certain types of information

Symbol	Meaning
 A0011182	**Permitted** Indicates procedures, processes or actions that are permitted.
 A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
 A0011193	**Tip** Indicates additional information.
 A0015482	Reference to documentation
 A0015484	Reference to page
 A0015487	Reference to graphic
1. , 2. , ...	Series of steps
 A0018343	Result of a sequence of actions
 A0015502	Visual inspection

1.2.5 Symbols in graphics

Symbol	Meaning
1, 2, 3, 4, ...	Item numbers
1. , 2. , ...	Series of steps
A, **B**, **C**, **D**, ...	Views

1.2.6 Symbols at the device

Symbol	Meaning
 A0019159	**Safety instructions** Observe the safety instructions contained in the associated Operating Instructions.
	**Connecting cable immunity to temperature change** Indicates that the connecting cables have to withstand a temperature of 85°C at least.

1.2.7 Registered trademarks

KALREZ®, VITON®, TEFLON®
Registered label of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP®
Registered label of Ladish & Co., Inc., Kenosha, USA

HART®
Registered trademark of the FieldComm Group, Austin, USA

GORE-TEX®
Registered label of W.L. Gore & Associates, Inc., USA

2 Basic safety instructions

2.1 Requirements concerning the staff

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists: must have a relevant qualification for this specific function and task
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations

- Before beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- Following instructions and basic conditions

The operating personnel must fulfill the following requirements:
- Being instructed and authorized according to the requirements of the task by the facility's owner-operator
- Following the instructions in these Operating Instructions

2.2 Designated use

The **Deltapilot M** is a hydrostatic pressure sensor for measuring level and pressure.

2.2.1 Incorrect use

The manufacturer is not liable for damage caused by improper or non-designated use.
Verification for borderline cases:
For special fluids and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-wetted materials, but does not accept any warranty or liability.

2.3 Workplace safety

For work on and with the device:
- Wear the required personal protective equipment according to federal/national regulations.
- Switch off the supply voltage before connecting the device.

2.4 Operational safety

Risk of injury!
- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for interference-free operation of the device.
- ▶ Only disassemble the device in pressurless condition!

Conversions to the device
Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:
- ▶ If, despite this, modifications are required, consult with Endress+Hauser.

Repair
To ensure continued operational safety and reliability,
- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to repair of an electrical device.
- ▶ Use original spare parts and accessories from Endress+Hauser only.

2.5 Hazardous area

To eliminate a danger for persons or for the facility when the device is used in the hazardous area (e.g. explosion protection, pressure vessel safety):

- Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area.
- Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

2.6 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the- art safety requirements, has been tested, and left the factory in a condition in which they are safe to operate. It fulfills general safety requirements and legal requirements. It also conforms to the EC directives listed in the device-specific EC declaration of conformity. Endress+Hauser confirms this fact by applying the CE mark.

2.7 Functional Safety SIL (optional)

If using devices for applications with safety integrity, the Functional Safety Manual (SD00347P/00/EN) must be observed thoroughly.

3 Identification

3.1 Product identification

The following options are available for identification of the measuring device:

- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter serial numbers from nameplates in W@M Device Viewer (www.endress.com/deviceviewer): All information about the measuring device is displayed.

For an overview of the technical documentation provided, enter the serial number from the nameplates in the W@M Device Viewer (www.endress.com/deviceviewer).

3.2 Scope of delivery

The scope of delivery comprises:

- Device
- Optional accessories

Documentation supplied:

- Operating Instruction BA00382P is available on the Internet.
  → See: www.endress.com → Download

- Brief Operating Instruction: KA01033P Deltapilot M
- Final inspection report
- Additional Safety Instructions for ATEX, IECEx and NEPSI devices
- Optional: factory calibration form, test certificates

3.3 CE mark, Declaration of Conformity

The devices are designed to meet state-of-the-art safety requirements, have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations as listed in the EC Declaration of Conformity and thus comply with the statutory requirements of the EC Directives. Endress+Hauser confirms the conformity of the device by affixing to it the CE mark.

4 Installation

4.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

4.2 Storage and transport

4.2.1 Storage

The device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).
Storage temperature range:
See Technical Information for Deltapilot M TI00437P.

4.2.2 Transport

⚠ WARNING

Incorrect transportation

Housing, diaphragm and capillaries may become damaged, and there is a risk of injury!

- ▶ Transport the measuring device to the measuring point in its original packaging or by the process connection.
- ▶ Follow the safety instructions and transport conditions for devices weighing more than 18 kg (39.6 lbs).
- ▶ Do not use capillaries as a carrying aid for the diaphragm seals.

4.3 Installation conditions

4.3.1 Dimensions

→ For dimensions, please refer to the Technical Information for Deltapilot M TI00437P, "Mechanical construction" section.

4.4 General installation instructions

- Devices with a G 1 1/2 thread:
  When screwing the device into the tank, the flat seal has to be positioned on the sealing surface
  of the process connection. To avoid additional strain on the process isolating diaphragm, the thread should never be sealed with hemp or similar materials.
- Devices with NPT threads:
  - Wrap Teflon tape around the thread to seal it.
  - Tighten the device at the hexagonal bolt only. Do not turn at the housing.
  - Do not overtighten the thread when screwing. Max. torque: 20 to 30 Nm (14.75 to 22.13 lbf ft)

4.4.1 Mounting sensor modules with PVDF thread

⚠ WARNING

Risk of damage to process connection!

Risk of injury!

▶ Sensor modules with PVDF process connections with threaded connection must be installed with the mounting bracket provided!

⚠ WARNING

Material fatigue from pressure and temperature!

Risk of injury if parts burst! The thread can become loose if exposed to high pressure and temperatures.

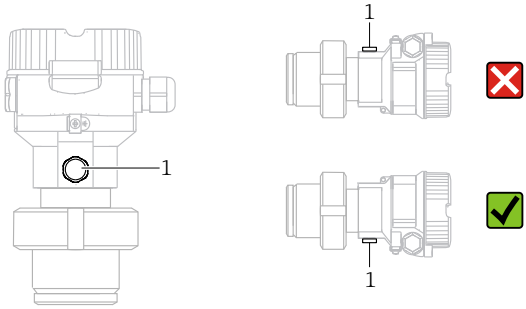
▶ The integrity of the thread must be checked regularly and the thread may need to be re-tightened with the maximum tightening torque of 7 Nm (5.16 lbf ft). Teflon tape is recommended for sealing the ½" NPT thread.

4.5 Installing

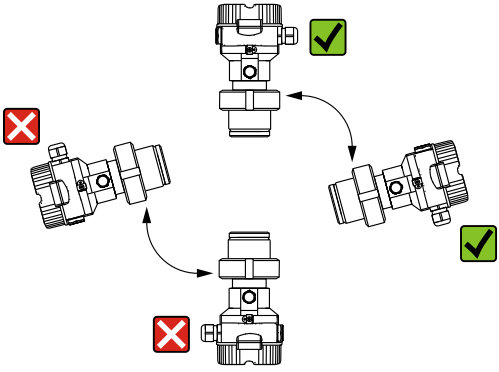
- Due to the orientation of the Deltapilot M, there may be a shift in the zero point, i.e. when the container is empty or partially full, the measured value does not display zero. You can correct this zero point shift → 📄 25, Section "Function of the operating elements" or → 📄 37, Section 8.4 "Position zero adjustment".
- The local display can be rotated in 90° stages.
- Endress+Hauser offers a mounting bracket for installing on pipes or walls.
  → 📄 14, Section 4.5.6 "Wall and pipe mounting (optional)".

4.5.1 General installation instructions

- Do not clean or touch process isolating diaphragms with hard or pointed objects.
- The process isolating diaphragm in the rod and cable version is protected against mechanical damage by a plastic cap.
- If a heated Deltapilot M is cooled during the cleaning process (e.g. by cold water), a vacuum develops for a short time, whereby moisture can penetrate the sensor through the pressure compensation (1). If this is the case, mount the Deltapilot M with the pressure compensation (1) pointing downwards.



- Keep the pressure compensation and GORE-TEX® filter (1) free from contamination.
- The device must be installed as follows in order to comply with the cleanability requirements of the ASME-BPE (Part SD Cleanibility).:



4.5.2 FMB50

Level measurement

- Always install the device below the lowest measuring point.
- Do not install the device at the following positions:
  - in the filling curtain
  - in the tank outflow
  - in the suction area of a pump

– or at a point in the tank that can be affected by pressure pulses from the agitator
- The calibration and functional test can be carried out more easily if you mount the device downstream of a shutoff device.
- Deltapilot M must be included in the insulation for media that can harden when cold.

Pressure measurement in gases

- Mount Deltapilot M with shutoff device above the tapping point so that any condensate can flow into the process.

Pressure measurement in steams

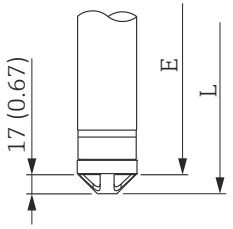
- Mount Deltapilot M with siphon above the tapping point.
- Fill the siphon with liquid before commissioning.
  The siphon reduces the temperature to almost the ambient temperature.

Pressure measurement in liquids

- Mount Deltapilot M with the shutoff device below or at the same level as the tapping point.

4.5.3 FMB51/FMB52/FMB53

- When mounting rod and cable versions, make sure that the probe head is located at a point as free as possible from flow. To protect the probe from impact resulting from lateral movement, mount the probe in a guide tube (preferably made of plastic) or secure it with a clamping fixture.
- In the case of devices for hazardous areas, comply strictly with the safety instructions when the housing cover is open.
- The length of the extension cable or the probe rod is based on the planned level zero point. The height of the protective cap must be taken into consideration when designing the layout of the measuring point. The level zero point (E) corresponds to the position of the process isolating diaphragm.
  Level zero point = E; top of the probe = L.



4.5.4 Mounting the FMB53 with a suspension clamp

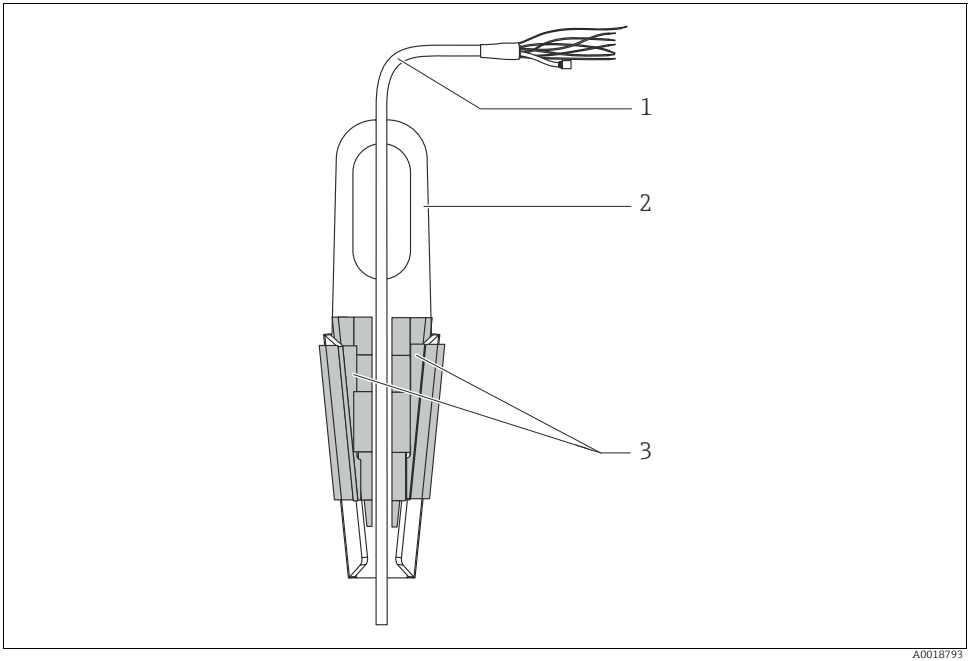


Fig. 1: Mounting with a suspension clamp

1 Extension cable
2 Suspension clamp
3 Clamping jaws

Mounting the suspension clamp:

1. Mount the suspension clamp (item 2). When selecting the place to fix the unit, take the weight of the extension cable (item 1) and the device into account.
2. Raise the clamping jaws (item 3). Position the extension cable (item 1) between the clamping jaws as illustrated in Figure.
3. Hold the extension cable in position (item 1) and push the clamping jaws (item 3) back down.
   Tap the clamping jaws gently from above to fix them in place.

4.5.5 Seal for flange mounting

NOTICE

Distorted measurement results.

The seal is not allowed to press on the process isolating diaphragm as this could affect the measurement result.

▶ Ensure that the seal is not touching the process isolating diaphragm.

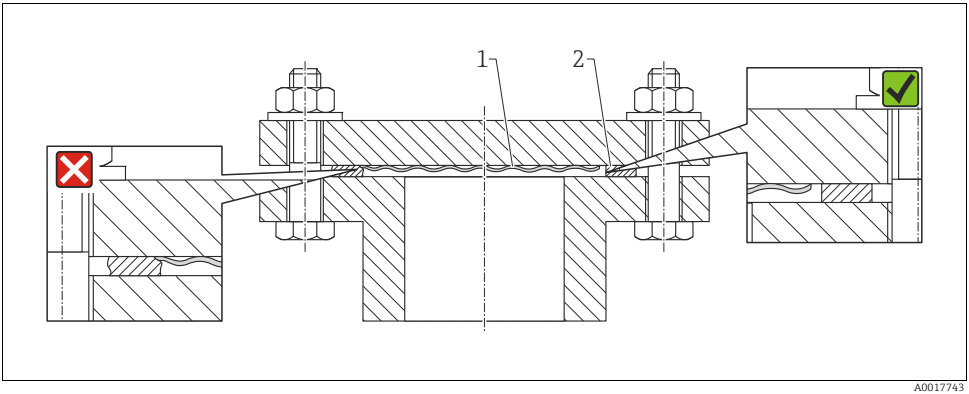


Fig. 2:
1 Process isolating diaphragm
2 Seal

4.5.6 Wall and pipe mounting (optional)

Mounting bracket

See operating instructions.

4.5.7 Assembling and mounting the "separate housing" version

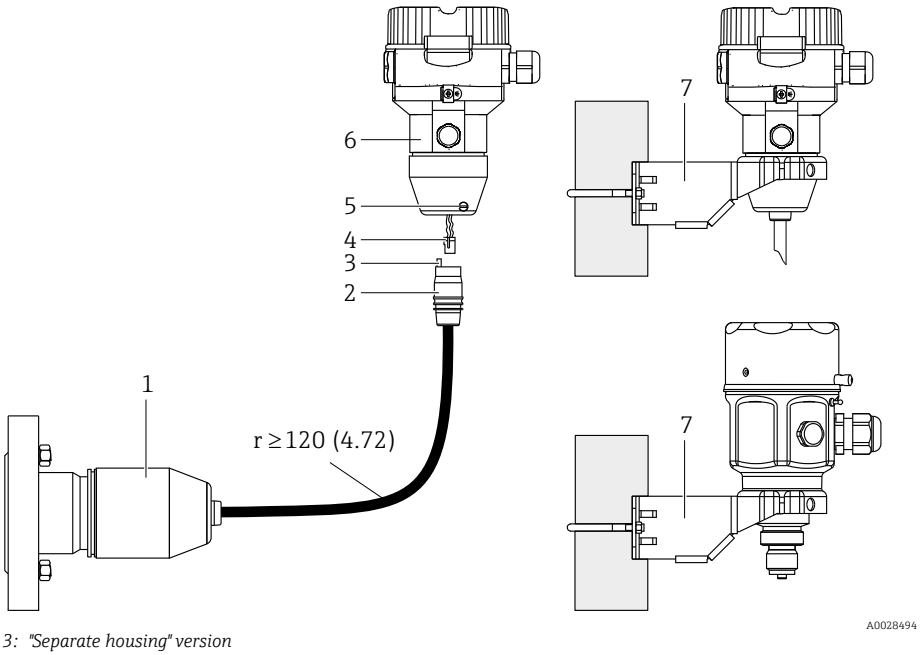


Fig. 3: "Separate housing" version

1 In the case of the "separate housing" version, the sensor is delivered with the process connection and cable ready mounted.
2 Cable with connection jack
3 Pressure compensation
4 Connector
5 Locking screw
6 Housing mounted with housing adapter, included
7 Mounting bracket provided, suitable for pipe and wall mounting (for pipes from 1 1/4" up to 2" diameter)

Maßeinheit mm (in)

Assembly and mounting

1. Insert the connector (item 4) into the corresponding connection jack of the cable (item 2).
2. Plug the cable into the housing adapter (item 6).
3. Tighten the locking screw (item 5).
4. Mount the housing on a wall or pipe using the mounting bracket (item 7).
   When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbf ft). Mount the cable with a bending radius (r) ≥ 120 mm (4.72 in).

Routing the cable (e.g. through a pipe)

You require the cable shortening kit.

Order number: 71093286
For details on mounting, see SD00553P/00/A6.

4.5.8 Supplementary installation instructions

Sealing the probe housing
- Moisture must not penetrate the housing when mounting the device, establishing the electrical connection and during operation.
- Always firmly tighten the housing cover and the cable entries.

4.6 Mounting of the profile seal for universal process mounting adapter

For details on mounting, see KA00096F/00/A3.

4.7 Closing the housing cover

NOTICE

Devices with EPDM cover seal - transmitter leakiness!
Mineral-based, animal-based or vegetable-based lubricants cause the EPDM cover seal to swell and the transmitter to become leaky.
▶ The thread is coated at the factory and therefore does not require any lubrication.

NOTICE

The housing cover can no longer be closed.
Damaged thread!
▶ When closing the housing cover, please ensure that the thread of the cover and housing are free from dirt, e.g. sand.If you feel any resistance when closing the cover, check the thread on both again to ensure that they are free from dirt.

4.7.1 Closing the cover on the stainless steel housing

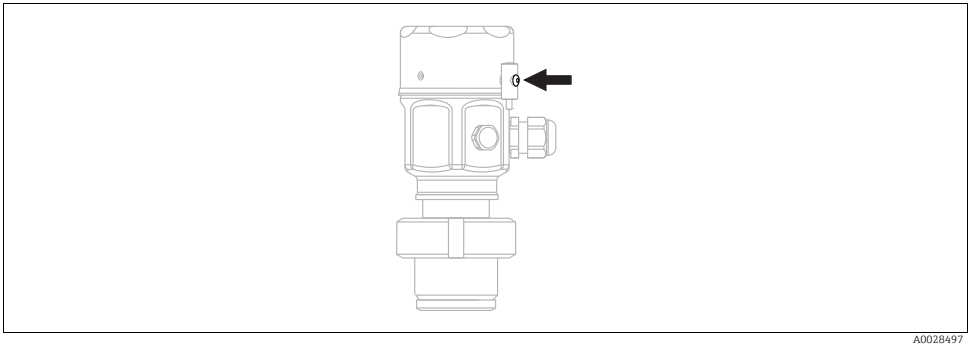


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Fig. 4: Closing the cover

The cover for the electronics compartment is tightened by hand at the housing until the stop. The screw serves as DustEx protection (only available for devices with DustEx approval).

4.8 Post-installation check

O	Is the device undamaged (visual inspection)?
O	Does the device comply with the measuring point specifications? For example: ▪ Process temperature ▪ Process pressure ▪ Ambient temperature range ▪ Measuring range
O	Are the measuring point identification and labeling correct (visual inspection)?
O	Is the device adequately protected against precipitation and direct sunlight?
O	Are the securing screw and securing clamp tightened securely?

5 Electrical connection

5.1 Connecting the device

⚠ WARNING

Supply voltage might be connected!

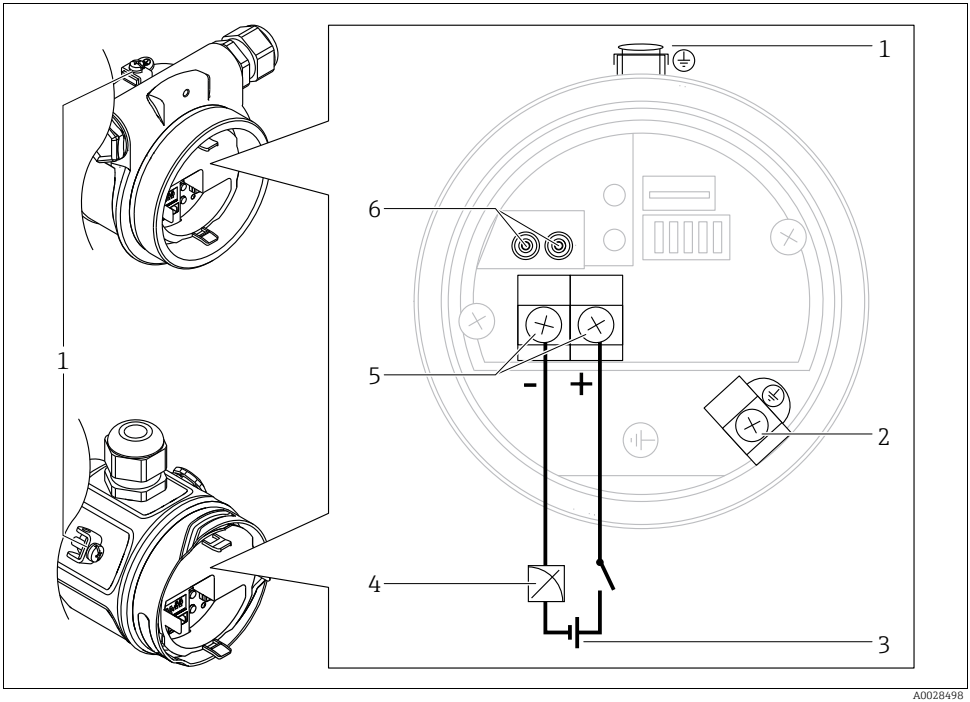
Risk of electric shock and/or explosion!

- ▶ Ensure that no uncontrolles processes are activated in the system.
- ▶ Switch off the supply voltage before connecting the device.
- ▶ When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- ▶ A suitable circuit breaker must be provided for the device in accordance with IEC/EN61010.
- ▶ Devices with integrated overvoltage protection must be grounded.
- ▶ Protective circuits against reverse polarity, HF influences and overvoltage peaks are integrated.

Connect the device in the following order:

1. Check that the supply voltage corresponds to the supply voltage indicated on the nameplate.
2. Switch off the supply voltage before connecting the device.
3. Remove housing cover.
4. Guide the cable through the gland. Preferably use a twisted, shielded two-wire cable.

5. Connect the device in accordance with the following diagram.
6. Screw down the housing cover.
7. Switch on the supply voltage.



Electrical connection 4...20 mA HART

1 External ground terminal
2 Grounding terminal
3 Supply voltage: 11,5 ... 45 VDC (versions with plug connectors: 35 V DC)
4 4 to 20 mA
5 Terminals for supply voltage and signal
6 Test terminals

5.1.1 Connecting devices with a Harting connector Han7D

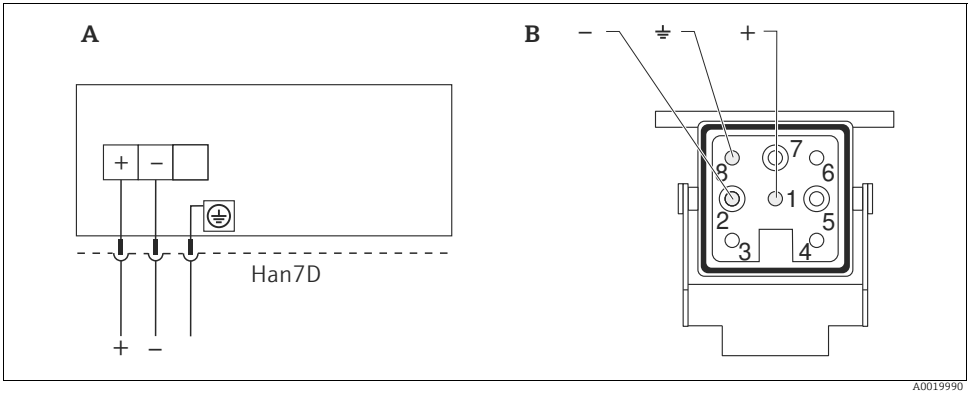


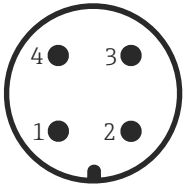
Fig. 5:

A Electrical connection for devices with Harting plug Han7D
B View of the connection on the device

Material: CuZn, gold-plated contacts of plug-in jack and connector

5.1.2 Connecting devices with an M12 connector

PIN assignment for M12 connector

PIN assignment for M12 connector	PIN	Meaning
	1	Signal +
	2	Not assigned
	3	Signal –
	4	Earth

5.1.3 Devices with valve connector

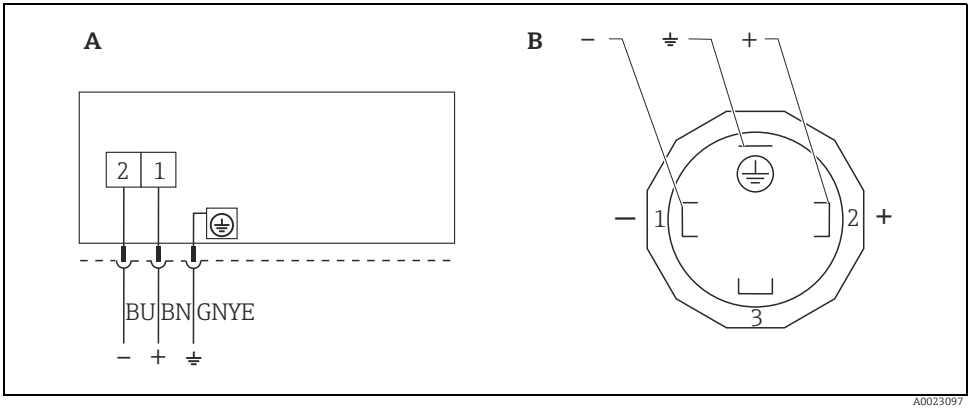


Fig. 6: BN = brown, BU = blue, GNYE = green/yellow

A Electrical connection for devices with valve connector
B View of the connection on the device

Material: PA 6.6

5.2 Connecting the measuring unit

5.2.1 Supply voltage

Electronic version	
4 to 20 mA HART, for non-hazardous areas	11.5 to 45 V DC (versions with plug-in connector 35 V DC)

Taking 4 to 20 mA test signal

A 4 to 20 mA test signal may be measured via the test terminals without interrupting the measurement. To keep the corresponding measured error below 0.1%, the current measuring device should exhibit an internal resistance of < 0.7 Ω.

5.2.2 Terminals

- Supply voltage and internal ground terminal: 0.5 to 2.5 mm^2 (20 to 14 AWG)
- External ground terminal: 0.5 to 4 mm^2 (20 to 12 AWG)

5.2.3 Cable specification

- Endress+Hauser recommends using twisted, shielded two-wire cables.

- Cable outer diameter: 5 to 9 mm (0.2 to 0.35 in) depends on the used cable gland (see technical information)

5.2.4 Load

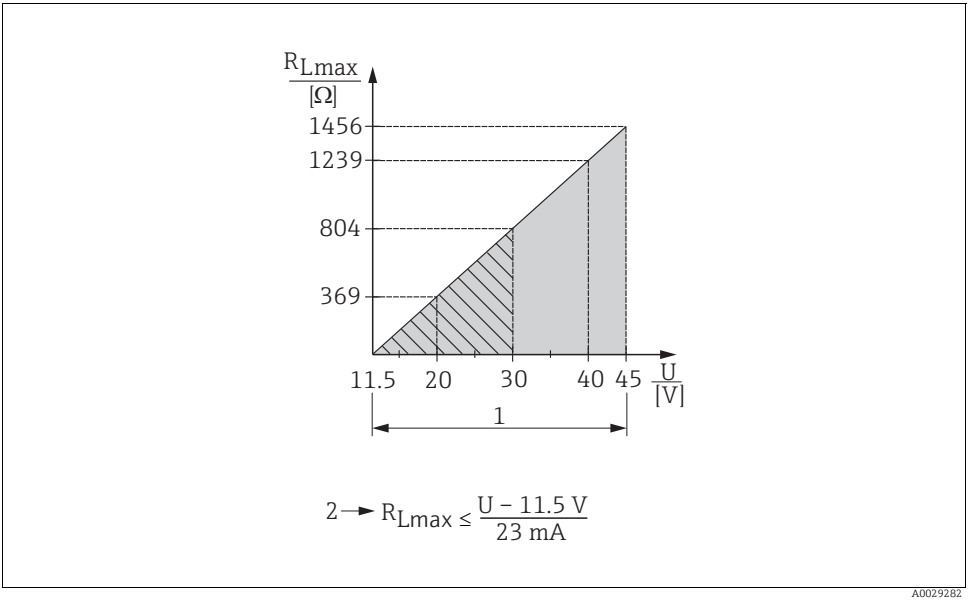


Fig. 7: Load diagram

1 Supply voltage 11.5 to 45 V DC (versions with plug-in connector 35 V DC) for other types of protection and for uncertified device versions
2 R_{Lmax} Maximum load resistance
U Supply voltage

When operating via a handheld terminal or via a PC with an operating program, a minimum communication resistance of 250 Ω must be taken into account.

5.2.5 Shielding/potential equalization

- A normal device cable suffices if only the analog signal is used. A shielded cable is recommended if using the HART protocol. Observe grounding concept of the plant.
- When using in hazardous areas, you must observe the applicable regulations. Separate Ex documentation with additional technical data and instructions is included with all Ex systems as standard. Connect all devices to the local potential equalization.

5.2.6 Connecting Field Xpert SFX100

See operating instructions.

5.2.7 Connecting Commubox FXA195

See operating instructions.

5.3 Overvoltage protection (optional)

See operating instructions.

5.4 Post-connection check

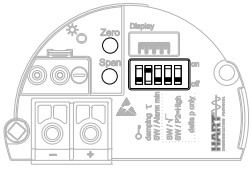
Perform the following checks after completing electrical installation of the device:
- Does the supply voltage match the specifications on the nameplate?
- Is the device properly connected?
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

As soon as voltage is applied to the device, the green LED on the electronic insert lights up for a few seconds or the connected local display lights up.

6 Operation

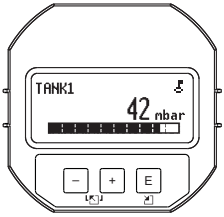
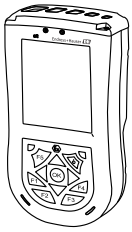
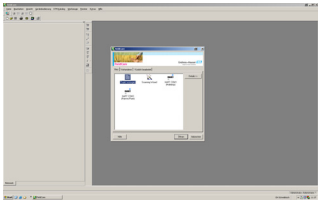
6.1 Operating options

6.1.1 Operation without operating menu

Operating options	Explanation	Graphic illustration	Description
Local operation without device display	The device is operated using the operating keys and DIP switches on the electronic insert.		→ 24

6.1.2 Operation with operating menu

Operation with an operating menu is based on an operation concept with "user roles" → 26.

Operating options	Explanation	Graphic illustration	Description
Local operation with device display	The device is operated using the operating keys on the device display.		→ 28
Remote operation via HART handheld terminal	The device is operated using the HART handheld terminal (e.g. SFX100).		→ 32
Remote operation via FieldCare	The device is operated using the FieldCare operating tool.		→ 32

6.2 Operation without operating menu

6.2.1 Position of operating elements

The operating keys and DIP switches are located on the electronic insert in the device.

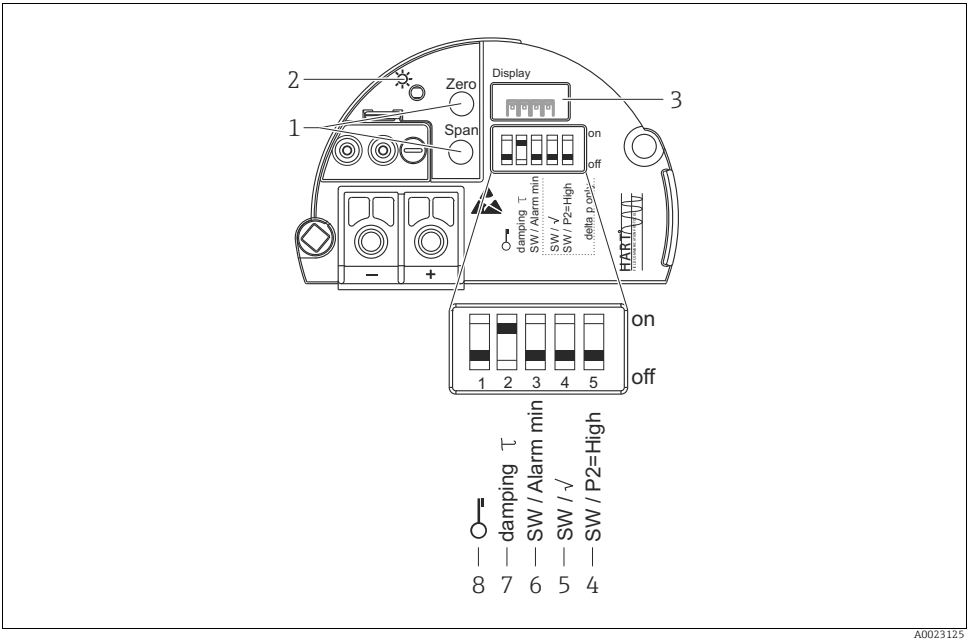


Fig. 8: HART electronic insert

1 Operating keys for lower range value (zero) and upper range value (span)
2 Green LED to indicate successful operation
3 Slot for optional local display
4+5 DIP switch only for Deltabar M
6 DIP switch for alarm current SW / Alarm Min (3.6 mA)
7 DIP switch for switching damping on/off
8 DIP switch for locking/unlocking parameters relevant to the measured value

Function of the DIP switches

Switches	Symbol/ labeling	Switch position	
		"off"	"on"
1		The device is unlocked. Parameters relevant to the measured value can be modified.	The device is locked. Parameters relevant to the measured value cannot be modified.

Switches	Symbol/ labeling	Switch position	
		"off"	"on"
2	damping τ	Damping is switched off. The output signal follows measured value changes without any delay.	Damping is switched on. The output signal follows measured value changes with the delay time τ.[1)]
3	SW/Alarm min	The alarm current is defined by the setting in the operating menu. ("Setup" -> "Extended setup" -> "Curr. output" -> "Output fail mode")	The alarm current is 3.6 mA regardless of the setting in the operating menu.
The following switches only for Deltabar M:			
4			
5			

1) The value for the delay time can be configured via the operating menu ("Setup" -> "Damping").
Factory setting: τ = 2 s or as per order specifications.

Function of the operating elements

Operating key(s)	Meaning
"Zero" pressed for at least 3 seconds	**Get LRV** ▪ **"Pressure" measuring mode** The pressure present is accepted as the lower range value (LRV). ▪ **"Level" measuring mode, "In pressure" level selection, "Wet" calibration mode** The pressure present is assigned to the lower level value ("Empty calibration"). No function is assigned to the key if level selection = "In height" and/or calibration mode = "Dry"
"Span" pressed for at least 3 seconds	**Get URV** ▪ **"Pressure" measuring mode** The pressure present is accepted as the upper range value (URV). ▪ **"Level" measuring mode, "In pressure" level selection, "Wet" calibration mode** The pressure present is assigned to the upper level value ("Full calibration"). No function is assigned to the key if level selection = "In height" and/or calibration mode = "Dry"
"Zero" and **"Span"** pressed simultaneously for at least 3 seconds	**Position adjustment** The sensor characteristic curve is shifted such that the pressure present becomes the zero value.
"Zero" and **"Span"** pressed simultaneously for at least 12 seconds	**Reset** All parameters are reset to the order configuration.

6.2.2 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorized and undesired access.

If operation is locked by means of the DIP switch, you can only unlock operation again by means of the DIP switch. If operation is locked by means of the operating menu, you can only unlock operation again using the operating menu.

Locking/unlocking via DIP switches

DIP switch 1 on the electronic insert is used to lock/unlock operation.
→ 24, "Function of the DIP switches".

6.3 Operation with an operating menu

6.3.1 Operation concept

The operation concept makes a distinction between the following user roles:

User role	Meaning
Operator	Operators are responsible for the devices during normal "operation". This is usually limited to reading process values either directly at the device or in a control room. If the work with the devices extends beyond value read-off tasks, the tasks involve simple, application-specific functions that are used in operation. Should an error occur, these users simple forward the information on the errors but do not intervene themselves.
Service engineer/technician	Service engineers usually work with the devices in the phases following device commissioning. They are primarily involved in maintenance and troubleshooting activities for which simple settings have to be made at the device. Technicians work with the devices over the entire life cycle of the product. Thus, commissioning and advanced settings and configurations are some of the tasks they have to carry out.
Expert	Experts work with the devices over the entire product life cycle, but their device requirements are often extremely high. Individual parameters/functions from the overall functionality of the devices are required for this purpose time and again. In addition to technical, process-oriented tasks, experts can also perform administrative tasks (e.g. user administration). "Experts" can avail of the entire parameter set.

6.3.2 Structure of the operating menu

User role	Submenu	Meaning/use
Operator	Language	Only consists of the "Language" parameter (000) where the operating language for the device is specified. The language can always be changed even if the device is locked.

User role	Submenu	Meaning/use
Operator	Display/operat.	Contains parameters that are needed to configure the measured value display (selecting the values displayed, display format, display contrast, etc.). With this submenu, users can change the measured value display without affecting the actual measurement.
Service engineer/technician	Setup	Contains all the parameters that are needed to commission measuring operations. This submenu has the following structure: ▪ **Standard setup parameters** A wide range of parameters, which can be used to configure a typical application, is available at the start. The measuring mode selected determines which parameters are available. After making settings for all these parameters, the measuring operation should be completely configured in the majority of cases. ▪ **"Extended setup" submenu** The "Setup" submenu contains additional parameters for more in-depth configuration of the measurement operation to convert the measured value and to scale the output signal. This menu is split into additional submenus depending on the measuring mode selected.
Service engineer/technician	Diagnosis	Contains all the parameters that are needed to detect and analyze operating errors. This submenu has the following structure: ▪ **Diagnostic list** Contains up to 10 error messages currently pending. ▪ **Event logbook** Contains the last 10 error messages (no longer pending). ▪ **Instrument info** Contains information on the device identification. ▪ **Measured values** Contains all the current measured values ▪ **Simulation** Is used to simulate pressure, level, current and alarm/warning. ▪ **Reset**
Expert	Expert	Contains all the parameters of the device (including those in one of the submenus). The "Expert" submenu is structured by the function blocks of the device. It thus contains the following submenus: ▪ **System** Contains all the device parameters that neither affect measurement nor integration into a distributed control system. ▪ **Measurement** Contains all the parameters for configuring the measurement. ▪ **Output** Contains all the parameters for configuring the current output. ▪ **Communication** Contains all the parameters for configuring the HART interface. ▪ **Application** Contains all the parameters for configuring the functions that go beyond the actual measurement (e.g. totalizer). ▪ **Diagnosis** Contains all the parameters that are needed to detect and analyze operating errors.

For an overview of the entire operating menu: see operating instructions.

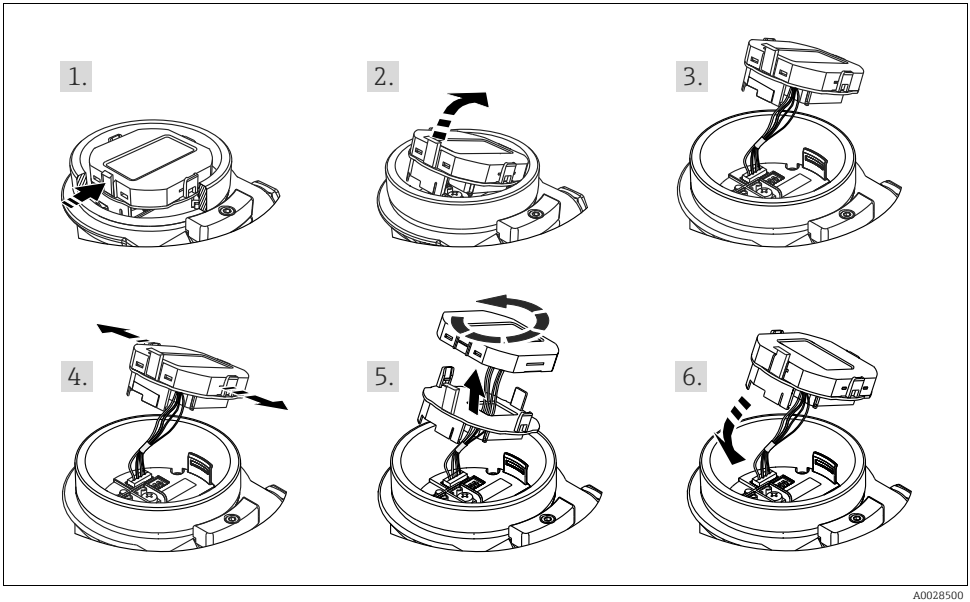
Direct access to parameters

The parameters can only be accessed directly via the "Expert" user role.

Parameter name	Description
Direct access (119) Entry Menu path: Expert → Direct access	Enter the direct access code to go directly to a parameter. **Options:** ▪ Enter the desired parameter code. **Factory setting:** 0 **Note:** For direct access, it is not necessary to enter leading zeros.

6.3.3 Operation with a device display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The local display shows measured values, dialog texts, fault messages and notice messages.
For easy operation the display can be taken out of the housing (see figure steps 1 to 3). It is connected to the device through a 90 mm (3.54 in) cable.
The display of the device can be turned in 90° stages (see figure steps 4 to 6).
Depending on the orientation of the device, this makes it easy to operate the device and read the measured values.



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Functions:
- 8-digit measured value display including sign and decimal point, bargraph for 4 to 20 mA HART as current display
- Three keys for operation
- Simple and complete menu guidance as parameters are split into several levels and groups
- Each parameter is given a 3-digit parameter code for easy navigation
- Possibility of configuring the display to suit individual requirements and preferences, such as language, alternating display, contrast setting, display of other measured values such as sensor temperature etc.
- Comprehensive diagnostic functions (fault and warning message etc.)

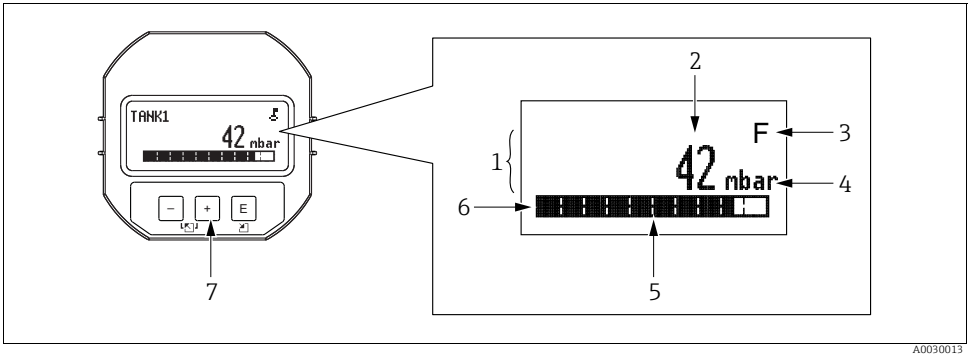

Fig. 9: Display

1 Main line
2 Value
3 Symbol
4 Unit
5 Bar graph
6 Information line
7 Operating keys

The following table illustrates the symbols that can appear on the local display. Four symbols can occur at one time.

Symbol	Meaning
	**Lock symbol** The operation of the device is locked. To unlock the device, → 32, Locking/unlocking operation.
	**Communication symbol** Data transfer via communication

Symbol	Meaning
S	**Error message "Out of specification"** The device is being operated outside its technical specifications (e.g. during warmup or cleaning processes).
C	**Error message "Service mode"** The device is in the service mode (during a simulation, for example).
M	**Error message "Maintenance required"** Maintenance is required. The measured value remains valid.
F	**Error message "Failure detected"** An operating error has occurred. The measured value is no longer valid.

Operating keys on the display and operating module

Operating key(s)	Meaning
+	– Navigate downwards in the picklist – Edit the numerical values and characters within a function
−	– Navigate upwards in the picklist – Edit the numerical values and characters within a function
E	– Confirm entry – Jump to the next item – Selection of a menu item and activation of the editing mode
+ and E	Contrast setting of local display: darker
− and E	Contrast setting of local display: brighter
+ and −	ESC functions: – Exit the edit mode for a parameter without saving the changed value. – You are in a menu at a selection level. Each time you press the keys simultaneously, you go up a level in the menu.

Operating example: Parameters with a picklist

Example: selecting "Deutsch" as the language of the menu.

	Language 000	Operation
1	✔ English Deutsch	"English" is set as the menu language (default value). A ✔ in front of the menu text indicates the active option.
2	Deutsch ✔ English	Select "Deutsch" with ⊞ or ⊟.
3	✔ Deutsch English	1. Confirm your choice with Ⓔ. A ✔ in front of the menu text indicates the active option ("Deutsch" is now selected as the menu language). 2. Exit the edit mode for the parameter with Ⓔ.

Operating example: User-definable parameters

Example: setting "Set URV" parameter from 100 mbar (1.5 psi) to 50 mbar (0.75 psi).

	Set URV 014	Operation
1	1 0 0 . 0 0 0 mbar	The local display shows the parameter to be changed. The value highlighted in black can be changed. The "mbar" unit is specified in another parameter and cannot be modified here.
2	**1** 0 0 . 0 0 0 mbar	1. Press ⊞ or ⊟ to get to the editing mode. 2. The first digit is highlighted in black.
3	**5** 0 0 . 0 0 0 mbar	1. Use ⊞ to change "1" to "5". 2. Confirm "5" with Ⓔ. The cursor jumps to the next position (highlighted in black). 3. Confirm "0" with Ⓔ (second position).
4	5 0 **0** . 0 0 0 mbar	The third position is highlighted in black and can now be edited.
5	5 0 ↵ . 0 0 0 mbar	1. Switch to the "↵" symbol with the ⊟ key. 2. Use Ⓔ to save the new value and exit the editing mode. → See next graphic.

	Set URV 014	Operation
6	5 **0** . 0 0 0 mbar	The new value for the upper range value is 50.0 mbar (0.75 psi). – You exit the edit mode for the parameter with E. – You can get back to the editing mode with + or −.

Operating example: Accepting the pressure present

Example: setting position adjustment

	Pos. zero adjust 007	Operation
1	✔ Abort Confirm	The pressure for position adjustment is present at the device.
2	Confirm ✔ Abort	Use + or − to switch to the "Confirm" option. The active option is highlighted in black.
3	Compensation accepted!	Accept the pressure present as position adjustment with the E key. The device confirms the adjustment and goes back to the "Pos. zero adjust" parameter.
4	✔ Abort Confirm	Exit the edit mode for the parameter with E.

6.3.4 Operation via SFX100

See operating instructions.

6.3.5 Operation via FieldCare

See operating instructions.

6.3.6 Locking/unlocking operation

See operating instructions.

6.3.7 Resetting to factory settings (reset)

See operating instructions.

7 Integrating transmitter using HART® protocol

See operating instructions.

8 Commissioning

The device is configured at the factory for the Level measuring mode. The measuring range and the unit in which the measured value is transmitted correspond to the specifications on the nameplate.

⚠ WARNING

Exceeding the maximum allowable working pressure!

Risk of injury due to bursting of parts! Warning messages are generated if pressure is too high.

- If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, the following messages are output in succession (depending on the setting in the "Alarm behavior" (050) parameter):
  "S140 Working range P" or "F140 Working range P"
  "S841 Sensor range" or "F841 Sensor range"
  "S971 Adjustment"
  Use the device only within the sensor range limits.

NOTICE

Shortfall of the allowable working pressure!

Output of messages if pressure is too low.

- If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, the following messages are output in succession (depending on the setting in the "Alarm behavior" (050) parameter):
  "S140 Working range P" or "F140 Working range P"
  "S841 Sensor range" or "F841 Sensor range"
  "S971 Adjustment"
  Use the device only within the sensor range limits.

8.1 Function check

Carry out a post-installation and a post-connection check as per the checklist before commissioning the device.

- "Post-installation check" checklist → Chap. 4.8
- "Post-connection check" checklist → Chap. 5.4

8.2 Commissioning without an operating menu

8.2.1 Pressure measuring mode

If no local display is connected, the following functions are possible by means of the keys on the electronic insert:
- Position adjustment (zero point correction)
- Setting lower range value and upper range value
- Device reset → 25

- Operation must be unlocked. → 32, "Locking/unlocking operation"
- The device is configured for the "Pressure" measuring mode as standard. You can switch measuring modes by means of the "Measuring mode" parameter. → 37, "Measuring mode selection"
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

⚠ WARNING

Changing the measuring mode affects the span (URV)!

This situation can result in product overflow.

▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured!

Carrying out position djustment.[1)]	
Pressure is present at device.	
↓	
Press the "Zero" and "Span" keys simultaneously for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure for position adjustment has not been accepted. Observe the input limits.

Setting lower range value.	
Desired pressure for lower range value is present at device.	
↓	
Press the "Zero" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for lower range value has been accepted.	Applied pressure for lower range value has not been accepted. Observe the input limits.

Setting upper range value.	
Desired pressure for upper range value is present at device.	
↓	
Press the "Span" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for upper range value has been accepted.	Applied pressure for upper range value has not been accepted. Observe the input limits.

1) Observe warning on commissioning (→ 33)

8.2.2 Level measuring mode

The following functions are possible by means of the keys on the electronic insert:
- Position adjustment (zero point correction)
- Setting the lower and upper pressure value and assigning to the lower and upper level value
- Device reset → 25

- The "Zero" and "Span" keys only have a function with the following setting:
  – "Level selection" = "In pressure", "Calibration mode" = "Wet"
  The keys have no function in other settings.
- The device is configured for the "Pressure" measuring mode as standard. You can switch measuring modes by means of the "Measuring mode" parameter. → 37, "Measuring mode selection"
  The following parameters are set to the following values at the factory:
  – "Level selection" = "In pressure"
  – "Calibration mode": wet
  – "Unit before lin": %
  – "Empty calib.": 0.0
  – "Full calib.": 100.0
  – "Set LRV": 0.0 (corresponds to 4 mA value)
  – "Set URV": 100.0 (corresponds to 20 mA value)
- Operation must be unlocked. → 32, "Locking/unlocking operation".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

⚠ WARNING

Changing the measuring mode affects the span (URV)!

This situation can result in product overflow.

▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured!

Carrying out position adjustment.[1)]	**Setting lower pressure value.**	**Setting upper pressure value.**
Pressure is present at device.	Desired pressure for lower pressure value ("empty pressure") is present at device.	Desired pressure for upper pressure value ("full pressure") is present at device.
↓	↓	↓
Press the "Zero" and "Span" keys simultaneously for at least 3 s.	Press the "Zero" key for at least 3 s.	Press the "Span" key for at least 3 s.
↓	↓	↓
Does the LED on the electronic insert light up briefly?	Does the LED on the electronic insert light up briefly?	Does the LED on the electronic insert light up briefly?

Carrying out position adjustment.[1]	
Yes	No
↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure for position adjustment has not been accepted. Observe the input limits.

Setting lower pressure value.	
Yes	No
↓	↓
The pressure present was saved as the lower pressure value ("empty pressure") and assigned to the lower level value ("empty calibration").	The pressure present was not saved as the lower pressure value. Observe the input limits.

Setting upper pressure value.	
Yes	No
↓	↓
The pressure present was saved as the upper pressure value ("full pressure") and assigned to the upper level value ("full calibration").	The pressure present was not saved as the upper pressure value. Observe the input limits.

1) Observe warning on commissioning (→ 🖹 33)

8.3 Commissioning with an operating menu

Commissioning comprises the following steps:
1. Function check (→ 🖹 33)
2. Selecting the language, measuring mode and pressure unit (→ 🖹 36)
3. Position adjustment (→ 🖹 37)
4. Configuring measurement:
   - Pressure measurement (→ 🖹 52 ff)
   - Level measurement (→ 🖹 38 ff)

8.3.1 Selecting the language, measuring mode and pressure unit

Language selection

Parameter name	Description
Language (000) Selection Menu path: Main menu → Language	Select the menu language for the local display. **Options:** ▪ English ▪ Another language (as selected when ordering the device) ▪ Possibly a third language (language of the manufacturing plant) **Factory setting**: English

Measuring mode selection

Parameter name	Description
Measuring mode (005) Selection Menu path: Setup → Measuring mode	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected. **⚠ WARNING** **Changing the measuring mode affects the span (URV)!** This situation can result in product overflow. ▶ If the measuring mode is changed, the span setting (URV) must be verified and, if necessary, reconfigured! **Options:** ▪ Pressure ▪ Level **Factory setting:** Pressure

Pressure unit selection

Parameter name	Description
Press. eng. unit (125) Selection Menu path: Setup → Press. eng. unit	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit. **Options:** ▪ mbar, bar ▪ mmH2O, mH2O, inH2O ▪ ftH2O ▪ Pa, kPa, MPa ▪ psi ▪ mmHg, inHg ▪ kgf/cm^2 **Factory setting:** mbar or bar depending on the sensor nominal measuring range, or as per order specifications

8.4 Position zero adjustment

The pressure resulting from the orientation of the device can be corrected here.

Parameter name	Description
Corrected press. (172) Display Menu path: Setup → Corrected press.	Displays the measured pressure after sensor trim and position adjustment. ℹ If this value is not equal to "0", it can be corrected to "0" by the position adjustment.

Parameter name	Description
Pos. zero adjust (007) (Gauge pressure sensor) Selection Menu path: Setup → Pos. zero adjust	Position zero adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. **Example:** – Measured value = 2.2 mbar (0.033 psi) – You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you assign the value 0.0 to the pressure present. – Measured value (after pos. zero adjust) = 0.0 mbar – The current value is also corrected. **Options** ▪ Confirm ▪ Abort **Factory setting:** Abort
Calib. offset (192) / (008) (absolute pressure sensor) Entry	Position adjustment – the pressure difference between set point and the measured pressure must be known. **Example:** – Measured value = 982.2 mbar (14.73 psi) – You correct the measured value with the value entered (e.g. 2.2 mbar (0.033 psi)) via the "Calib. offset" parameter. This means that you are assigning the value 980.0 (14.7 psi) to the pressure present. – Measured value (after calib. offset) = 980.0 mbar (14.7 psi) – The current value is also corrected. **Factory setting:** 0.0

8.5 Level measurement

8.5.1 Information on level measurement

- The limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Customer-specific units are not possible.
- There is no unit conversion.
- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure", "Empty height/Full height" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a warning message displayed, if the values are too close together.

You have a choice of two methods for calculating the level: "In pressure" and "In height". The table in the "Overview of level measurement" section that follows provides you with an overview of these two measuring tasks.

8.5.2 Overview of level measurement

Measuring task	Level selection	Measured variable selection	Description	Measured value display
Calibration is performed by entering two pressure-level value pairs.	"In pressure"	Via the "Unit before lin" parameter: %, level, volume or mass units.	– Calibration with reference pressure (wet calibration), see → 39 – Calibration without reference pressure (dry calibration), see → 41	The measured value display and the "Level before lin" parameter display the measured value.
Calibration is performed by entering the density and two height-level value pairs.	"In height"		– Calibration with reference pressure (wet calibration), see → 44 – Calibration without reference pressure (dry calibration), see → 47	

8.5.3 "In pressure" level selection
Calibration with reference pressure (wet calibration)

Example:
In this example, the level in a tank should be measured in "m". The maximum level is 3 m (9.8 ft). The pressure range is set to 0 to 300 mbar (4.5 psi).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.

The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a warning message displayed, if the values are too close together. Further limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the measuring device to be able to measure correctly.

	Description
1	Perform "position adjustment".→ 🖹 37
2	Select the "Level" measuring mode via the "Measuring mode (005)" parameter. Menu path: Setup → Measuring mode
3	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection.
4	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
5	Select a level unit via the "Unit before lin" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Unit before lin
6	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
7	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter. Menu path: Setup → Extended setup → Level → Adjust density
8	The pressure for the lower calibration point is present at the device, here 0 mbar for example.
	Select the "Empty calib." parameter. Menu path: Setup → Extended setup → Level → Empty calib.
	Enter the level value, here 0 m for example. The pressure value present is assigned to the lower level value by confirming the value.

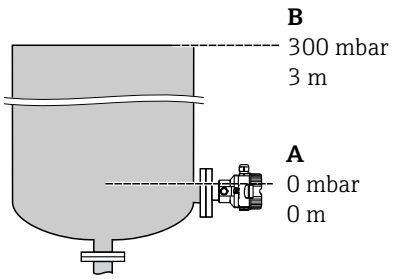

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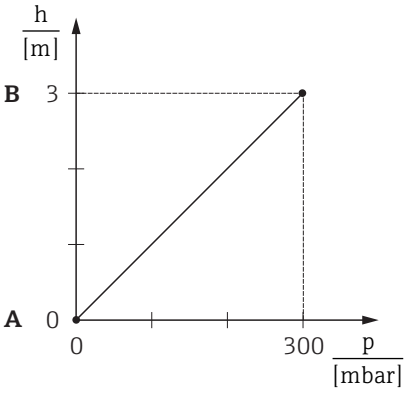
Fig. 10: Calibration with reference pressure – wet calibration

A See Table, Step 8.
B See Table, Step 9.



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	Description
9	The pressure for the upper calibration point is present at the device, here 300 mbar (4.5 psi) for example.
	Select the "Full calib." parameter. Menu path: Setup → Extended setup → Level → Full calib.
	Enter the level value, here 3 m (9.8 ft) for example. The pressure value present is assigned to the upper level value by confirming the value.
10	Set the level value for the lower current value (4 mA) by means of "Set LRV". Menu path: Setup → Extended setup → Current output → Set LRV
11	Set the level value for the upper current value (20 mA) by means of "Set URV". Menu path: Setup → Extended setup → Current output → Set URV
12	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density
13	Result: The measuring range is set for 0 to 3 m (9.8 ft).

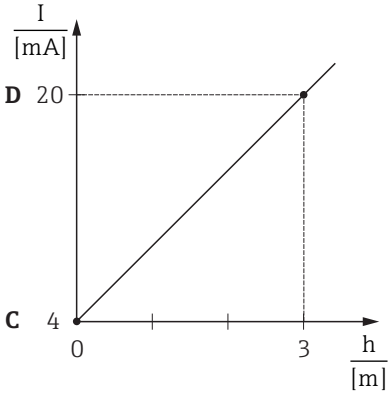


Fig. 11: Calibration with reference pressure – wet calibration

A See Table, Step 8.
B See Table, Step 9.
C See Table, Step 10.
D See Table, Step 11.

The measured variables %, level, volume and mass are available for this level mode. See operating instructions "Unit before lin (025)".

8.5.4 "In pressure" level selection
Calibration without reference pressure (dry calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a pressure of 450 mbar (6.75 psi). The minimum volume of 0 liters corresponds to a pressure of 50 mbar (0.75 psi) since the device is mounted below the start of the level measuring range.

Prerequisite:
- The measured variable is in direct proportion to the pressure.

- This is a theoretical calibration i.e. the pressure and volume values for the lower and upper calibration point must be known.

- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a warning message displayed, if the values are too close together. Further limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the measuring device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment, see → 37, "Position zero adjustment".

	Description
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
4	Select a level unit via the "Unit before lin" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Unit before lin
5	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
6	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here 0 liters for example. Menu path: Setup → Extended setup → Level → Empty calib.

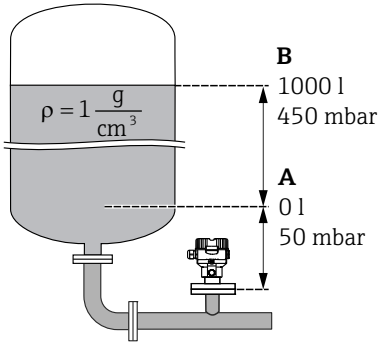
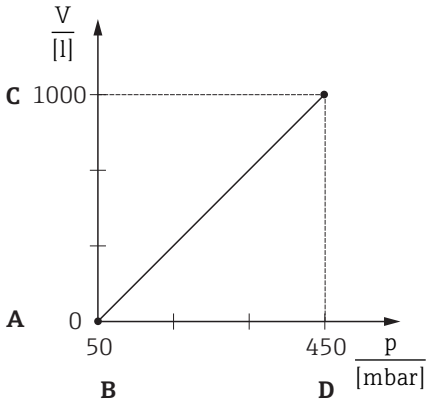


Fig. 12: Calibration without reference pressure – dry calibration

A See Table, Steps 6 and 7.
B See Table, Steps 8 and 9.

	Description
7	Enter the pressure value for the lower calibration point via the "Empty pressure" parameter, here 50 mbar (0.75 psi) for example. Menu path: Setup → Extended setup → Level → Empty pressure
8	Enter the volume value for the upper calibration point via the "Full calib." parameter, here 1000 liters (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
9	Enter the pressure value for the upper calibration point via the "Full pressure" parameter, here 450 mbar (6,75 psi) for example. Menu path: Setup → Extended setup → Level → Full pressure
10	"Adjust density" contains the factory setting 1.0 but this value can be changed if required. The value pairs subsequently entered must correspond to this density. Menu path: Setup → Extended setup → Level → Adjust density
11	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
13	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density
14	Result: The measuring range is set for 0 to 1000 l (264 US gal).



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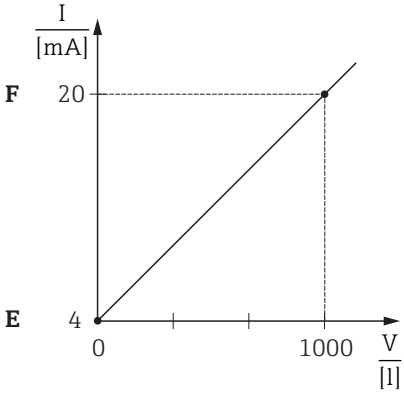

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Fig. 13: Calibration with reference pressure – wet calibration

A See Table, Step 6.
B See Table, Step 7.
C See Table, Step 8.
D See Table, Step 9.
E See Table, Step 11.
F See Table, Step 12.

The measured variables %, level, volume and mass are available for this level mode. See see operating instructions "Unit before lin (025)".

8.5.5 "In height" level selection
Calibration with reference pressure (wet calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4.5 m (15 ft). The minimum volume of 0 liters corresponds to a level of 0.5 m (1.6 ft) since the device is mounted below the start of the level measuring range.
The density of the medium is 1 g/cm^3 (1 SGU).

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.

The values entered for "Empty calib./Full calib.", " Set LRV/Set URV" and the pressures present at the device must be at least 1% apart. The value will be rejected, and a warning message displayed, if the values are too close together. Other limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.

	Description
1	Perform position adjustment. See → 37.
2	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
4	Select a pressure unit via the "Press eng. unit" parameter, here mbar for example. Menu path: Setup → Press. eng. unit
5	Select a level unit via the "Unit before lin" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Unit before lin

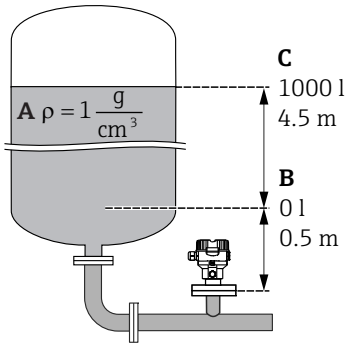
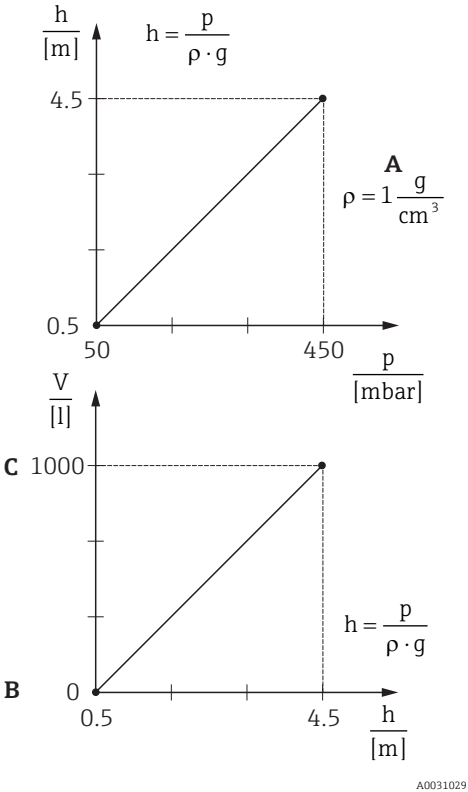


Fig. 14: Calibration with reference pressure – wet calibration

A See Table, Step 10.
B See Table, Step 8.
C See Table, Step 9.

	Description
6	Select a level unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit
7	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
8	The pressure for the lower calibration point is present at the device, here "50 mbar" (0.75 psi) for example.
	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here 0 liters for example. (The pressure currently measured is displayed as the height, here 0.5 m (1.6 ft) for example.) Menu path: Setup → Extended setup → Level → Empty calib.
9	The pressure for the upper calibration point is present at the device, here "450 mbar" (6.75 psi) for example.
	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liters" (264 US gal) for example. The pressure currently measured is displayed as the height, here "4.5 m" (15 ft) for example. Menu path: Setup → Extended setup → Level → Full calib.
8	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter, here "1 g/cm³" (1 SGU) for example. Menu path: Setup → Extended setup → Level → Adjust density
11	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
13	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density



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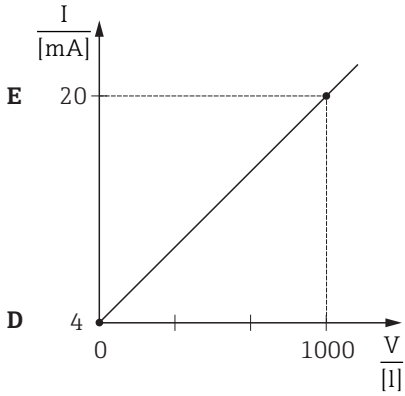
	Description	
14	Result: The measuring range is set for 0 to 1000 l (264 US gal).	 A0031065 *Fig. 15: Calibration with reference pressure – wet calibration* *E See Table, Step 10.* *F See Table, Step 8.* *G See Table, Step 9.* *H See Table, Step 11* *I See Table, Step 12.*

The measured variables %, level, volume and mass are available for this level mode see operating instructions "Unit before lin (025)".

8.5.6 "In height" level selection
Calibration without reference pressure (dry calibration)

Example:
In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4.5 m (15 ft). The minimum volume of 0 liters corresponds to a level of 0.5 m (1.6 ft) since the device is mounted below the start of the level measuring range.

Prerequisite:
- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i.e. the height and volume values for the lower and upper calibration point must be known.

- The values for "Empty calib./Full calib.", "Empty height/Full height" and" Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a warning message displayed, if the values are too close together. Further limit values are not checked, i.e. the values entered must be appropriate for the sensor and the measuring task for the measuring device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment, see → 37, "Position zero adjustment".

	Description
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
4	Select a level unit via the "Unit before lin" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Unit before lin
5	Select a level unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit
6	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
7	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here 0 liters for example. Menu path: Setup → Extended setup → Level → Empty calib.

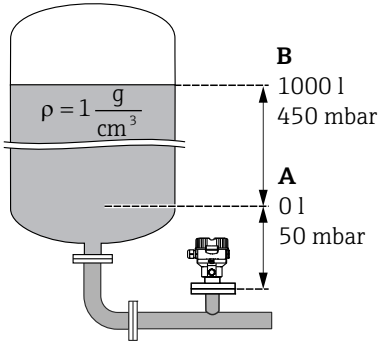
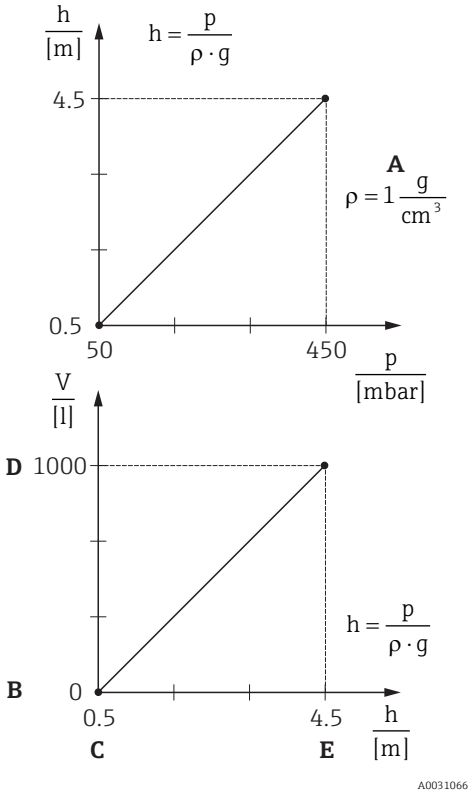
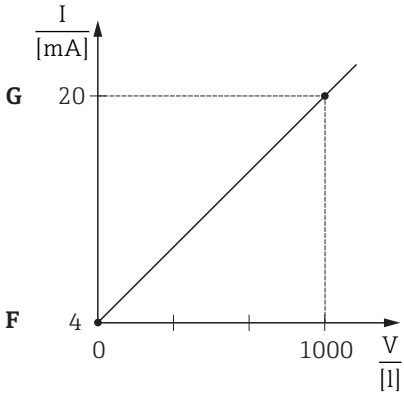


Fig. 16: Calibration without reference pressure – dry calibration

A See Table, Step 11.
B See Table, Steps 7 and 8.
D See Table, Steps 9 and 10.

	Description
8	Enter the height value for the lower calibration point via the "Empty height" parameter, here 0.5 m (1.6 ft) for example. Menu path: Setup → Extended setup → Level → Empty height
9	Enter the volume value for the upper calibration point via the "Full calib." parameter, here 1000 liters (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
10	Enter the height value for the upper calibration point via the "Full height" parameter, here 4.5 m (15 ft) for example. Menu path: Setup → Extended setup → Level → Full height
11	Enter the density of the medium via the "Adjust density" parameter, here "1 g/cm³" (1 SGU) for example. Menu path: Setup → Extended setup → Level → Adjust density
12	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
13	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
14	If the process uses a medium other than that on which the calibration was based, the new density has to be specified in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density



	Description	
15	Result: The measuring range is set for 0 to 1000 l (264 US gal).	 A0031067 *Fig. 17: Calibration with reference pressure – wet calibration* *A See Table, Step 11.* *B See Table, Step 7.* *C See Table, Step 8.* *D See Table, Step 9.* *E See Table, Step 10.* *F See Table, Step 12.* *G See Table, Step 13.*

The measured variables %, level, volume and mass are available for this level mode see operating instructions "Unit before lin (025)".

8.5.7 Calibration with partially-filled tank (wet calibration)

Example:
In this example a wet calibration is shown when it is not possible to empty the vessel and then fill it up to 100%. Here a 20% filling is used as “Empty” and a “25%” filling is used as “Full” calibration point. The calibration is then extended to 0% ... 100% and LRV / URV are adjusted accordingly.

Prerequisite:
The default value in the level mode for calibration mode is “Wet”.
However, it can be changed via: Setup → Extended Setup → Level → Calibration mode

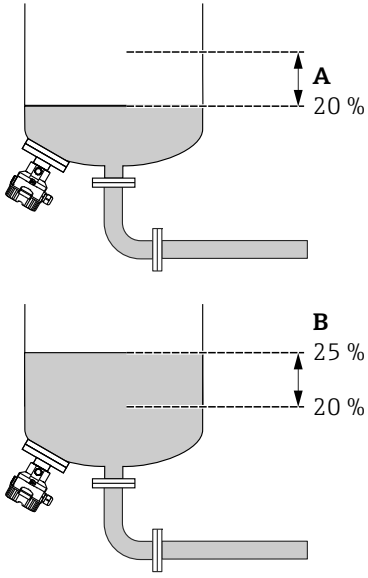
	Description	
1	Select the "Level" measuring mode via the "Measuring mode (005)" parameter. Menu path: Setup → Measuring mode (005)	
2	Set value for "Empty calib." with acting pressure for Level e.g. 20%. Menu path: Setup → Extended Setup → Level → Empty calibration	
3	Set value for "Full calib." with acting pressure for Level e.g. 25%. Menu path: Setup → Extended Setup → Level → Full calibration	
4	The values for full and empty pressure are measured automatically at adjustment. As the transmitter automatically sets the pressure values that suit to empty and full calibration to min and max pressure that cause the output current, it is necessary to set the right upper range value (URV) and lower range value (LRV).	

Abb. 18: Calibration with partially-filled tank

A See Table, Step 2
B See Table, Step 3

It is also possible to use different liquids (e.g. water) for the adjustment. In this case you have to enter the different densities at following menu path:
- Setup → Ext. Setup → Level → Adjust density (034) (e.g. 1.0 kg/l for water)
- Setup → Ext. Setup → Level → Process density (035) (e.g. 0.8 kg/l for oil)

8.6 Linearization

See operating instructions.

8.7 Pressure measurement

8.7.1 Calibration without reference pressure (dry calibration)

Example:
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:
This is a theoretical calibration, i.e. the pressure values for the lower and upper range are known.

Due to the orientation of the device, there may be pressure shifts in the measured value, i.e. the measured value is not zero in a pressureless condition. For information on how to perform position adjustment, see → 37.

	Description
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the "Set LRV" parameter. Menu path: Setup → Set LRV
	Enter the value for the "Set LRV" parameter (here 0 mbar) and confirm. This pressure value is assigned to the lower current value (4 mA).
4	Select the "Set URV" parameter. Menu path: Setup → Set URV
	Enter the value for the "Set URV" parameter (here 300 mbar (4.5 psi)) and confirm. This pressure value is assigned to the upper current value (20 mA).
5	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).

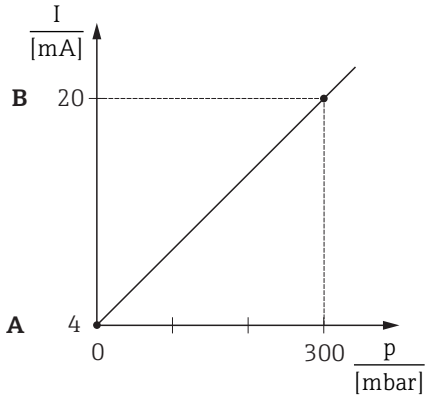


Fig. 19: Calibration without reference pressure

A See Table, Step 3.
B See Table, Step 4.

8.7.2 Calibration with reference pressure (wet calibration)

Example:
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 to +300 mbar (4.5 psi) measuring range, i.e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:
The pressure values 0 mbar and 300 mbar (4.5 psi) can be specified. The device is already mounted, for example.

For a description of the parameters mentioned, see operating instructions "Description of parameters".

	Description
1	Perform position adjustment → 37.
2	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
4	The pressure for the lower-range value (4 mA value) is present at the device, here 0 mbar for example.
	Select the "Get LRV" parameter. Menu path: Setup → Extended setup → Current output → Get LRV.
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the lower current value (4 mA).
5	The pressure for the upper-range value (20 mA value) is present at the device, here 300 mbar (4.5 psi) for example.
	Select the "Get URV" parameter. Menu path: Setup → Extended setup → Current output → Get URV.
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the upper current value (20 mA).
6	Result: The measuring range is configured for 0 to +300 mbar (4.5 psi).

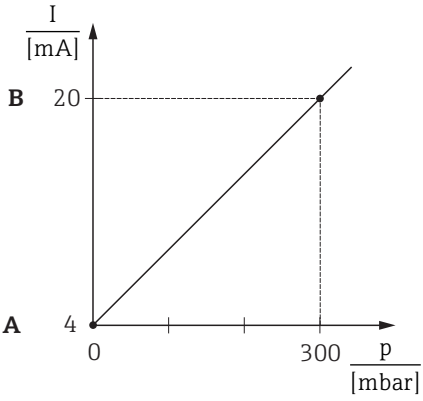


Fig. 20: Calibration with reference pressure

A See Table, Step 4.
B See Table, Step 5.

8.8 Electrical differential pressure measurement with gauge pressure sensors

See operating instructions.

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